

UTILITY
PATENT APPLICATION
TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

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TORU WAKANA

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APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

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1. ☐ Fee Transmittal Form
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i. ☐ **DELETION OF INVENTOR(S)**
Signed Statement attached deleting
inventor(s) named in the prior application, see
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5. ☐ Incorporation By Reference (useable if Box 4c is checked)
The entire disclosure of the prior application, from which a copy of
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9. ☐ 37 CFR 3.73(b) Statement ☐ Power of Attorney
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12. ☐ Preliminary Amendment

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14. ☐ Small Entity ☐ Statement filed in prior application
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CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS (37 CFR 1.16(c))	11-20 =	0	X \$ 18.00 =	\$ 0.00
	INDEPENDENT CLAIMS (37 cfr 1.16(b))	4-3 =	1	X \$ 78.00 =	\$ 78.00
	MULTIPLE DEPENDENT CLAIMS (if applicable) (37 CFR 1.16(d))			\$260.00 =	\$ 0.00
				BASIC FEE (37 CFR 1.16(a))	\$690.00
			Total of above Calculations =		\$768.00
	Reduction by 50% for filing by small entity (Note 37 CFR 1.9, 1.27, 1.28).				
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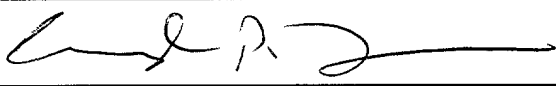
20. ☒ A check in the amount of \$768.00 to cover the filing fee is enclosed.

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- a. ☒ Fees required under 37 CFR 1.16.
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SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

NAME	LEONARD P. DIANA, Reg. No. 29,296
SIGNATURE	
DATE	May 26, 2000

TITLE OF THE INVENTION

IMAGE PROCESSING APPARATUS AND IMAGE PROCESSING METHOD

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FIELD OF THE INVENTION

The present invention relates to an image processing apparatus, having a function to perform rasterizing in band units, performs rendering, and an image processing method.

10

BACKGROUND OF THE INVENTION

Conventionally, as an image processing apparatus of this type, a so-called page printer is known. In this apparatus, image processing is performed while holding raster data for one page in a raster memory. The raster data in such image processing apparatus includes not only text but also various images such as a simple figure and a photograph.

In recent years, the resolution of this image processing apparatus has improved, and the memory capacity necessary in accordance with the improvement in resolution has increased. For example, in a resolution of 600 dpi, for generating data for an A4-sized page, a 4 MByte memory is required. The tonality, with which 1 pixel has been conventionally represented by 2 levels, has improved from 16 (4 bits) to 256 (8 bits) levels,

thus requiring a larger raster memory. Further, recently, color data is handled in many cases. In such cases, in YMCK space, in comparison with a case of monochrome image processing, the memory capacity for further 4
5 planes is required, therefore, the memory size is further increasing.

To cut costs increased by such increase in memory size, various memory-saving techniques are proposed. For example, the quantity of a raster memory is suppressed
10 by holding raster data of a band-size and encoding the raster data of bands.

However, in known decoding methods, it is necessary to temporarily store decoded data in a buffer before video transfer is performed to a printer engine.
15 To prevent data underflow to the print engine, it is necessary to perform parallel processing to video transfer one band from one buffer to the printer engine while decode the next band in another buffer. According to the method, two work buffers are necessary, and in
20 comparison with a decoding method in which a work buffer is not required, redundant memories are required. Thus the memory area for storing coded data is reduced.

SUMMARY OF THE INVENTION

25

The present invention has been made to solve the

above-described conventional problems, and has its object to provide a high-quality image processing apparatus and image processing method capable of image transfer processing by using a fixed size work buffer, even if different decoding methods are used, without physically increasing the memory.

To attain the above object, the present invention provides an image processing apparatus comprising: first coding means for performing coding by band having a predetermined height; first decoding means for decoding data coded by said first coding means into bitmap data; memory means for storing bitmap data for one band decoded by said first decoding means; second coding means for encoding the bitmap data stored in said memory means by a coding method selected from plural coding methods; and second decoding means for selecting and performing a first decoding method capable of transferring the bitmap data to a printer engine in realtime, or a second decoding method which needs to render the bitmap data before transferring the data to the printer engine, in accordance with the coding method selected by said second coding means, wherein before coding is performed by said first coding means, decoding processing performed by said second decoding means is predicted, and if the predicted decoding processing is the second decoding processing, the band height is

reduced to half of that in case of the first decoding processing.

Further, the present invention provides an image processing apparatus comprising: memory means including
5 a first area for storing coded representation of image data and a second area for storing raster image data of at least a band; coded-representation forming means for translating respective image data of plural bands into coded representation and storing the coded
10 representation into said first area of said memory means; rendering means for rendering the coded representation from said first area into said second area, in said memory means; coding means for encoding the raster image data rendered in said second area into
15 coded data and storing the coded data by page in said memory means; decoding means for decoding said coded data; decoding-method discrimination means for discriminating whether decoding method performed by said decoding means is a first decoding method capable of
20 transferring decoded raster image data to a printer engine in real time, or a second decoding method for rendering the decoded raster image data in a memory and then transferring the data to the printer engine; and
band-height setting means for setting a band height
25 based on the result of discrimination by said decoding-method discrimination means.

If decoding is performed by said second decoding method in accordance with the result of discrimination by said decoding-method discrimination means, said band-height setting means sets the band height to half of
5 that of the first decoding method.

The image processing apparatus further comprises input means for inputting image data in page description language.

The coded-representation forming means converts
10 said page description language into coded representation including at least one of a bitmap object, a run length object, a trapezoidal object, a box object, and a fixed-boundary code object.

The image processing apparatus further comprises
15 age-type discrimination means for discriminating an image type of said image data, wherein said coding means selects a coding method corresponding to the image type discriminated by said image-type discrimination means from plural coding methods and performs coding by the
20 selected coding method.

The image processing apparatus further comprises release means for releasing said first area in which said coded representation is stored after generation of coded page by said coding means.

25 Further, the present invention provides an image processing method for encoding input image data in band

units and storing coded data for one page, then
transferring the coded data to a printer engine while
decoding the data, comprising: a discrimination step of
discriminating whether or not a decoding method for
5 temporarily rendering decoded raster image data in a
memory and then transferring the data to the printer
engine is used, based on input image data; and a band-
height setting step of, if it is discriminated at said
discrimination step that said decoding method is used,
10 setting a band height to half of that where said
decoding method is not used.

The image processing method further comprises: a
translation step of translating the input image data
into coded representation by each band having the height
15 set at said band-height setting step; a first storage
step of storing said coded representation; a rendering
step of rendering the stored coded representation by
band into a band raster image; a second storage step of
storing said rendered band raster image; a coding step
20 of encoding the stored band raster image and storing
said coded data for one page; and decode and transfer
steps of temporarily rendering coded data by band and
then transferring the rendered data to a printer engine.

At said decoding and transfer step, a memory for
25 two-band raster images is used as a double buffer, and
decode and transfer steps are performed in parallel.

Further, the present invention provides a storage medium containing program code, read and executed by a computer, to function as an image processing apparatus which encodes input image data by band and stores coded
5 data for one page, and transfers the coded data to a printer engine while decoding the data, said program code including: program code for discriminating whether or not a decoding method for temporarily rendering decoded raster image data in a memory and then
10 transferring the data to the printer engine is used, based on input image data; and band-height setting program code for, if it is discriminated that said decoding method is used, setting a band height to half of that where said decoding method is not used.

15 Other features and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings, in which like reference characters designate the same name or similar parts throughout the figures
20 thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated
25 in and constitute a part of the specification, illustrate embodiments of the invention and, together

with the description, serve to explain the principles of the invention.

Fig. 1 is a schematic cross-sectional view showing the structure of an image processing apparatus according to an embodiment of the present invention;

Fig. 2 is a block diagram showing the construction of a printer control unit of the image processing apparatus;

Fig. 3 is a flowchart showing the flow of entire page generation processing in the image processing apparatus;

Fig. 4 is a flowchart showing the flow of coding method selection processing in the image processing apparatus;

Fig. 5 is a flowchart showing the flow of decoding method checking processing in the image processing apparatus;

Fig. 6 is a flowchart showing the flow of band-height setting processing in the image processing apparatus;

Fig. 7 is a flowchart showing the flow of coded-page generation processing in the image processing apparatus;

Fig. 8 is a flowchart showing the flow of decoding and transfer processing in the image processing apparatus;

Fig. 9 is a flowchart showing the flow of realtime decoding processing in the image processing apparatus;

Fig. 10 is a flowchart showing the flow of non-realtime decoding processing in the image processing
5 apparatus;

Fig. 11 is a flowchart showing the flow of 2-band parallel processing in the image processing apparatus;

Figs. 12 and 13 are block diagrams explaining the 2-band parallel processing in the image processing
10 apparatus;

Fig. 14 is a block diagram explaining an image processing technique of the present invention; and

Figs. 15 and 16 are block diagrams explaining image processing techniques according to the embodiment
15 of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment of the present invention
20 will now be described in detail in accordance with the accompanying drawings. Note that relative positioning of constituent elements, expressions, numerical values and the like described in the present embodiment do not limit the scope of the invention as long as there is no
25 specific description.

<First Embodiment>

[Construction]

Fig. 1 is a cross-sectional view showing the structure of a laser beam printer (hereinafter abbreviated to "LBP") according to an embodiment of the present invention. The LBP is capable of character pattern registration from a data source (not shown) and fixed format (form data) registration.

In Fig. 1, reference numeral 1000 denotes an LBP main body which inputs and stores character information (character code), form information or a macro command supplied from an externally-connected host computer, generates a corresponding character pattern or a form pattern in accordance with the information, and forms an image on a print sheet as a printing medium.

Numeral 1012 denotes an operation panel having switches for operation, an LED display and the like; and 1001, a printer control unit which controls the overall LBP 1000 and interprets character information or the like supplied from the host computer. The control unit 1001 mainly converts character information into a video signal of corresponding character pattern and outputs the signal to a laser driver 1002.

The laser driver 1002 is a circuit to drive semiconductor laser 1003. The laser driver 1002 turns on/off laser light 1004 emitted from the semiconductor laser 1003 in accordance with the input video signal.

The laser light 1004 is swept leftward and rightward by a rotary polygon mirror 1005, and scans on an electrostatic drum 1006. Thus an electrostatic latent image is formed on the electrostatic drum 1006. The latent image is developed by a developing unit 1007 around the electrostatic drum 1006, and is transferred to a print sheet.

The print sheet, which is a cut sheet, is set in a paper cassette 1008. The print sheet is fed into the apparatus with a paper-feed roller 1009 and conveyance rollers 1010 and 1011, and supplied to the electrostatic drum 1006.

Fig. 2 is a block diagram showing the construction of the control unit 1001 in the LBP 1000.

Numerals 2001 denotes an external device such as a host computer; 2003, an address data bus; 2004, a host I/F including a buffer; 2005, a CPU which controls the control unit; 2006, a ROM in which programs for control-unit control and the like are stored; 2007, a DMA controlled by the CPU; 2008 a panel unit; 2009, an I/F circuit including an output buffer for storing data to be sent to an engine 2011; and 2010, a RAM.

[Processing Technique]

Next, an image processing technique of the present invention will be described with reference to the block diagram of Fig. 14.

First, the control unit 1001 of the printer 1000 inputs image data in page description language (PDL) generated by the external device 2001 into the host I/F 2004.

5 Then, the CPU 2005 functions as a band-coded representation forming unit 1401 in accordance with a program for band coding processing stored in the ROM 2006, to convert the page description language inputted from the external device 2001 into band-coded
10 representation information where the data is divided in band units, and store the information in a band code area 1402 secured in the RAM 2010. The band-coded representation information is a generic name of drawing objects divided in band units, such as "bitmap", "run
15 length", "trapezoidal", "box", and "high-speed boundary-coded bitmap" with a background pattern, and a drawing logic upon rendering them in a raster memory. Note that the details of the band-coded representation information are disclosed in Japanese Published Patent Application
20 No. Hei 6-87251.

Next, the CPU 2005 renders the band-coded representation information in band units by using a rendering unit 1404, and stores the information into a band raster area 1403.

25 When the rendered raster data has been stored in the band raster area, the CPU 2005 sends a first band

via a transfer unit 1405 to the engine 2011 to output
the band. While the raster data of the band is outputted,
raster data of the next band is rendered in another band
raster area 1403. In this manner, data can be outputted
5 from the printer engine without causing data underflow
by alternately performing rendering in the band raster
area and transfer. Further, at the same time of transfer
(print) operation, band-coded representation of the next
page is generated.

10 However, in some cases, image data includes many
complicated drawing objects and the band code area 1402
becomes full, accordingly, all the drawing objects
cannot be stored as the band-coded representation
information. For example, there is a possibility that in
15 one band area in band code area, all the objects to be
rendered are not always stored. In this case, as all the
drawing objects do not exist in the band code area 1402,
if the data is raster-rendered in the band raster area
1403 as described above, a drawing object which cannot
20 be outputted is generated.

[Characteristic Processing Technique]

To solve the above problem, the coded
representation is temporarily rendered, and encoded
again by a high-compression rate coding method, such
25 that all the image information is stored in the band
code area. At this time, the control unit 1001 performs

the following page generation processing.

Fig. 3 is a flowchart showing the entire page generation processing.

At step S301, image data is inputted into the host
5 I/F unit 2004 from the external device such as a host
computer. It is preferable that the image data inputted
from the host I/F unit 2004 is not in full-raster image
format of print image but in compact data format such as
page description language (PDL) designating an object or
10 object position on a page. However, the image data may
be in any other image data format than the PDL format.

At step S302, the print mode of the input data is
interpreted and a coding method is selected. Next, at
step S303, a decoding method corresponding to the coding
15 is checked, and at step S304, a band height (width) is
set in accordance with the decoding method. In this
example, if the decoding method is a non-realtime
decoding method, the band height is reduced to half of
that in realtime decoding method.

20 The realtime decoding method is a method in which
video transfer to a printer engine after decoding is
capable of video-transferring decoded data without
temporarily storing the data in a work buffer. Further,
"band" is a generic name of each of several same-size
25 strip-shaped data obtained by dividing one-page data in
a number of strips. The height of each strip is defined

as a band height.

At steps S305 to S307, page generation and transfer processing is performed based on the band height set at step S304.

5 Fig. 15 shows the page generation and transfer processing in a case where the decoding processing is performed by the realtime decoding method in accordance with the result of checking at step S303.

 The input PDL is converted into band-coded
10 representation in the band-coded representation forming unit 1401 and stored into the band code area 1402. If all the image information cannot be stored in the pre-secured band code area, the information is rendered by the rendering unit 1404 by band, and stored into the
15 band raster area 1403. The band raster area has a capacity for storing bitmap data for one band. In this example, the band raster area 1403 and the band code area 1401 are separately provided, however, both areas exist on the RAM 2010. If the band raster area 1403
20 requires a larger area, the band code area 1401 is reduced. This relation is the same in Fig. 16.

 The bitmap data stored in the band raster area 1403 is encoded by the CPU 2005 functioning as the encoder 1501 by the method selected at step S302. The
25 coded data is stored in a compressed band area 1503. The band code area 1402 is sequentially released

corresponding to the bands stored in the compressed band area 1503. When coded data for one page has been stored in the compressed band area 1503, a decoder 1502 decodes the data by band, and sequentially transfers decoded
5 bitmap data via the transfer unit 1405 to the printer engine.

Fig. 16 shows the page generation and transfer processing in a case where the decoding processing is performed by the non-realtime decoding method in
10 accordance with the result of checking at step S303.

The input PDL is converted into band-coded representation in the band-coded representation forming unit 1401, and stored into the band code area 1402. At this time, the band height is set to the height set at
15 step S303, i.e., half of that in the realtime decoding method.

If all the image information cannot be stored in the pre-secured band code area, the information is rendered by the rendering unit 1404 by band, and stored
20 into the band raster area 1403. The band raster area has a capacity for storing bitmap data for one band.

The bitmap data stored in the band raster area 1403 is encoded by the CPU 2005 functioning as the encoder 1501 by the method selected at step S302. Then
25 the coded data is stored into the compressed band area 1503.

When coded data for one page has been stored in the compressed band area 1503, the decoder 1502 decodes the data by band, and renders the data in the band raster 1403. The band raster must have a capacity for two bands to transfer bitmap data to the printer engine without interruption. While rendering bitmap data in the band raster for one band, bitmap data from the other band raster is sequentially transferred to the printer engine. That is, two band rasters are used as a double buffer for parallel processing. Since the band height has been set to half in advance, in comparison with the case of decoding processing by using the realtime decoding method, the necessary band raster area does not increase to reduce the other memory area.

Hereinbelow, the respective processing at steps S302 to S304 and steps S306 to S307 will be described.
[Coding Method Selection]

Fig. 4 is a flowchart showing in detail the coding method selection processing at step S302.

At step S401, mode checking is performed. The mode in this case is one of color mode, monochrome mode, image mode and the like of data to be print-outputted. The color mode can be selected only in use of color printer. If it is determined in the mode checking at step S401 that the mode is the image mode, a coding method 1 is selected at step S402, and at step S405, the

coding method 1 is set as the coding method.

Similarly, if it is determined in the mode checking at step S401 that the mode is the color mode, a coding method 2 is selected at step S403, and at step 5 S405, the coding method 2 is set as the coding method. Further, if it is determined in the mode checking at step S401 that the mode is the monochrome mode, a coding method 3 is selected at step S404, and at step S405, the coding method 3 is set as the coding method.

10 Note that if the conditions of the image mode and the color mode or the monochrome mode overlap with each other, the image mode has a higher priority than the other modes in mode selection. Then, when coding method determination by mode has ended, the coding method 15 selection processing ends at step S406.

[Decoding Method Checking]

Fig. 5 is a flowchart showing in detail the decoding method checking processing at step S303.

At step S501, the coding method selected at step 20 S302 is obtained. At step S502, it is checked whether or not the realtime decoding method exists as a decoding method corresponding to the coding method obtained at step S501.

If it is determined at step S502 that the realtime 25 decoding method exists, the realtime decoding method is set as the decoding method at step S503. On the other

hand, if it is determined at step S502 that the realtime decoding does not exist, the non-real decoding method is set as the decoding method. When the decoding method has been set, the process ends.

5 [Band Height Setting]

Fig. 6 is a flowchart showing in detail the band-height setting processing at step S304.

Generally, the band height is determined relatively based on an area for storing one-page data.

10 The larger the height is, the less the amount of boundary raster between bands is, i.e., the smaller the amount of overlapped data, therefore, memory efficiency is higher. In this embodiment, the set band height is "H".

15 At step S601, the set band height (H) is obtained.

At step S602, the decoding method checked at step S303 in Fig. 3 is obtained.

At step S603, if the decoding method obtained at step S602 is the non-realtime decoding method, the
20 process proceeds to step S604, at which the band height is set to half ($H/2$). On the other hand, if the decoding method obtained at step S602 is the realtime decoding, the process proceeds to step S605, at which the band height is set with the same value (H).

25 Then the band-height setting processing ends.

[Coding Processing]

In band-coded representation, if all the image information cannot be stored in the band code area, a coded page is generated by processing as shown in Fig. 7.

Fig. 7 is a flowchart showing in detail the coded-page generation processing at step S306.

At step S701, a work memory is allocated. The work memory here means a band raster area for storing decoded bitmap data. The work memory has a capacity the same as that of the band generated in proportion to the band height determined at step S304. At step S702, a value "n" indicating a band number is initialized to "0". The value "n" is an integer satisfying

$$0 \leq n \leq n_max$$

n_max: an integer as a maximum band number

At step S703, it is checked whether or not the value "n" indicating the current band number exceeds "n_max". If the value "n" exceeds "n_max", it is determined that all the bands have been processed, and the processing ends at step S708. If it is determined at step S703 that the value "n" does not exceeds "n_max", the process proceeds to step S704.

At step S704, the band-coded representation at step S305 is rendered in the work memory obtained at step S701.

Next, at step S705, the bitmap data rendered in the work memory at step S704 is encoded by the coding method selected at step S302 in Fig 3.

At step S706, the coded data is stored into the
5 compressed band area 1503.

At step S707, the current band number "n" is incremented for the next band ($n = n + 1$).

The process returns to step S603, at which the above processing is repeated to the final band, then the
10 coded-page generation processing ends.

[Decoding and Transfer Processing]

Fig. 8 is a flowchart showing in detail the decoding and transfer processing at step S307.

At step S801, it is checked whether the coding
15 method selected by the decoding method checking at step S303 in Fig. 3 is a realtime decoding method or a non-realtime decoding method. If the decoding method is a realtime decoding method, the process proceeds to step S803, at which the realtime decoding processing is
20 performed, while if the decoding method is a non-realtime decoding method, the process proceeds to step S802, at which band decoding processing is performed.

Fig. 9 is a flowchart showing in detail the realtime decoding processing at step S803.

25 At step S901, a realtime decoding method is selected as the decoding method. At step S902, the

current band number "n" is initialized to "0". Note that the number "n" is an integer satisfying

$$0 \leq n \leq n_{\max}$$

5 n_{\max} : an integer as a maximum band number

At step S903, it is checked whether or not the current band number "n" exceeds " n_{\max} ". If the number "n" exceeds " n_{\max} ", it is determined that all the bands
10 have been decoded, and the process proceeds to step S906, at which the realtime decoding processing is terminated. On the other hand, if the current band number "n" does not exceeds " n_{\max} ", the process proceeds to step S904.

At step S904, coded data of the "n"-th band is
15 converted into a video signal and transferred to the printer engine while coded data is decoded, thus decoding and transfer of the band is performed.

At step S905, the current band number "n" is incremented for the next band " $n = n + 1$ ".

20 Then the process returns to step S903, at which the above processing is repeated to the final band, then the realtime decoding processing ends, and the decoding and transfer processing ends.

On the other hand, if it is determined at step
25 S801 in Fig. 8 that the decoding method is a non-realtime decoding method, the non-realtime decoding

processing is performed at step S802. The details of the non-realtime decoding processing will be described with reference to the flowchart of Fig. 10.

At step S1001, a non-realtime decoding method is
5 selected as the decoding method. Next, at step S1002, band processing is performed. The details of the band processing will be described with reference to the flowchart of Fig. 11.

At step S1101, a work memory for two bands is
10 obtained. The work memory has a memory size twice of that of the work memory obtained at step S701 in Fig. 7, but the memory size is the same as that of the work memory obtained upon realtime decoding ($H/2 \times 2$). That is, as the band height is reduced to half, there is no
15 difference in the size of the work memory between realtime decoding and non-realtime decoding. The respective work memories will be referred to as a work memory 1 and a work memory 2.

First, at step S1102, 0-th band coded data is
20 decoded and stored into the work memory 1.

At step S1103, the current band number "n" is initialized to "1".

Note that the number "n" is an integer satisfying

25 $1 \leq n \leq n_max$

n_max : an integer as a maximum band number

At step S1104, it is checked whether or not the current band number "n" exceeds the final band "n_max". If the number "n" does not exceed the final band "n_max",
5 the process proceeds to step S1105.

At step S1105, "n-1"-th band from the work memory 1 is converted into a video signal and transferred to the printer engine, thus decoding and transfer processing is performed on the "n-1"-th band. First, the
10 0-th band data decoded at step S1102 is processed. In parallel to this processing, the "n"-th band data is decoded and the decoded data is stored into the work memory 1. First, the 1-th band coded data is decoded and stored into the memory.

15 The process proceeds to step S1106, at which the current band number "n" is incremented to the next band number ($n = n + 1$)

Figs. 12 and 13 illustrate these processing.

First, in Fig. 12, the "n"-th band decoded data,
20 already decoded and stored in the work memory 1, is converted into a video signal and transferred to the printer engine, while the "n+1"-th band coded data is decoded and stored into the work memory 2.

Next, in Fig. 13, the data decoded in the work
25 memory 1 in Fig. 12 is similarly converted into a video signal and transferred to the printer engine, on the

other hand, as the "n"-th band data, already converted to the video signal is unnecessary, decoding is performed on "n+2"-th band data in the work memory 1.

The processing in Figs. 12 and 13 is continued
5 till the final band is processed.

Note that in this processing, decoding and storage to one work memory must be completed before the completion of video transfer from the other work memory to the printer engine.

10 Next, the process returns to step S1104 to continue the above processing until the final band is processed.

If it is determined at step S1104 that the final band has been processed, the decoding and transfer
15 processing ends.

[Other Embodiments]

In the above embodiment, the image mode, the color mode and the monochrome mode are handled in mode selection, however, other modes may be used.

20 In the above embodiment, three types of coding methods are used, however, the number of types of coding methods is not limited.

In the above embodiment, two or more bands are handled, however, more bands may be handled.

25 In the above embodiment, the work memory is allocated upon coding and decoding, however, a fixed

area may be provided.

In the above embodiment, two or more bands are handled, however, a single band may be handled.

In the above embodiment, in mode selection, if the
5 image mode and the color mode or monochrome mode overlap with each other, the image mode is a higher priority in mode selection, however, another mode may be a higher priority.

The present invention can be applied to a system
10 constituted by a plurality of devices (e.g., a host computer, an interface, a reader and a printer) or to an apparatus comprising a single device (e.g., a copy machine or a facsimile apparatus).

Further, the object of the present invention can
15 be also achieved by providing a storage medium storing program code for performing the aforesaid processes to a system or an apparatus, reading the program code with a computer (e.g., CPU, MPU) of the system or apparatus from the storage medium, then executing the program. In
20 this case, the program code read from the storage medium realizes the functions according to the embodiment, and the storage medium storing the program code constitutes the invention. Furthermore, besides aforesaid functions according to the above embodiment are realized by
25 executing the program code which is read by a computer, the present invention includes a case where an OS

(operating system) or the like working on the computer performs a part or entire processes in accordance with designations of the program code and realizes functions according to the above embodiment.

5 Furthermore, the present invention also includes a case where, after the program code read from the storage medium is written in a function expansion card which is inserted into the computer or in a memory provided in a function expansion unit which is connected to the
10 computer, CPU or the like contained in the function expansion card or unit performs a part or entire process in accordance with designations of the program code and realizes functions of the above embodiment.

 Where the present invention is applied to the
15 aforesaid storage medium, the storage medium stores program code corresponding to the above-described flowcharts (especially Fig. 3 and Fig. 6)

 According to the present invention, image transfer processing can be performed by using a fixed size work
20 buffer even if different decoding methods are used. Thus, high-quality image processing apparatus and image processing method capable of high-quality image processing without physically increasing memory capacity can be provided.

25 As many apparently widely different embodiments of the present invention can be made without departing from

the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

WHAT IS CLAIMED IS:

1. An image processing apparatus comprising:

first coding means for performing coding by band
having a predetermined height;

5 first decoding means for decoding data coded by
said first coding means into bitmap data;

memory means for storing the bitmap data for one
band decoded by said first decoding means;

second coding means for encoding the bitmap data
10 stored in said memory means by a coding method selected
from plural coding methods; and

second decoding means for selecting and performing
a first decoding method capable of transferring the
bitmap data to a printer engine in realtime, or a second
15 decoding method which needs to render the bitmap data
before transferring the data to the printer engine, in
accordance with the coding method selected by said
second coding means,

wherein before coding is performed by said first
20 coding means, a decoding method performed by said second
decoding means is predicted, and if the predicted
decoding method is the second decoding method, the band
height is reduced to half of that in case of the first
decoding method.

25

2. An image processing apparatus comprising:

memory means including a first area for storing coded representation of image data and a second area for storing raster image data of at least a band;

coded-representation forming means for translating
5 respective image data of plural bands into coded representation and storing the coded representation into said first area of said memory means;

rendering means for rendering the coded representation from said first area into said second
10 area, in said memory means;

coding means for encoding the raster image data rendered in said second area into coded data and storing the coded data by page in said memory means;

decoding means for decoding the coded data;

15 decoding-method discrimination means for discriminating whether decoding method performed by said decoding means is a first decoding method capable of transferring decoded raster image data to a printer engine in real time, or a second decoding method for
20 rendering the decoded raster image data in a memory and then transferring the data to the printer engine; and

band-height setting means for setting a band height based on the result of discrimination by said decoding-method discrimination means.

25

3. The image processing apparatus according to claim
2, wherein if decoding is performed by said second
decoding method in accordance with the result of
discrimination by said decoding-method discrimination
5 means, said band-height setting means sets the band
height to half of that in case of the first decoding
method.

4. The image processing apparatus according to claim
10 2, further comprising input means for inputting image
data in page description language.

5. The image processing apparatus according to claim
4, wherein said coded-representation forming means
15 converts said page description language into coded
representation including at least one of a bitmap object,
a run length object, a trapezoidal object, a box object,
and a fixed-boundary code object.

20 6. The image processing apparatus according to claim
2, further comprising image-type discrimination means
for discriminating an image type of said image data,
wherein said coding means selects a coding method
corresponding to the image type discriminated by said
25 image-type discrimination means from plural coding

methods and performs coding by the selected coding method.

7. The image processing apparatus according to claim
5 2, further comprising release means for releasing said first area in which said coded representation is stored after storing the coded page by page in said memory means by said coding means.

10 8. An image processing method for encoding input image data in band units and storing coded data for one page, then transferring the coded data to a printer engine while decoding the data, comprising:
a discrimination step of discriminating whether or
15 not a decoding method for temporarily rendering decoded raster image data in a memory and then transferring the data to the printer engine is used, based on input image data; and
a band-height setting step of, if it is
20 discriminated at said discrimination step that said decoding method is used, setting a band height to half of that where said decoding method is not used.

9. The image processing method according to claim 8,
25 further comprising:

a translation step of translating the input image data into coded representation by each band having the height set at said band-height setting step;

a first storage step of storing said coded
5 representation;

a rendering step of rendering the stored coded representation by band into a band raster image;

a second storage step of storing said rendered band raster image;

10 a coding step of encoding the stored band raster image and storing said coded data for one page; and
decode and transfer steps of temporarily rendering coded data by band and then transferring the data to a printer engine.

15 10. The image processing method according to claim 9, wherein at said decoding and transfer steps, a memory for two-band raster images is used as a double buffer, and decode and transfer step are performed in parallel.

20 11. A storage medium containing program code, read and executed by a computer, to function as an image processing apparatus which encodes input image data by band and stores coded data for one page, and transfers
25 the coded data to a printer engine while decoding the data, said program code including:

program code for discriminating whether or not a decoding method for temporarily rendering decoded raster image data in a memory and then transferring the data to the printer engine is used, based on input image data;

5 and

band-height setting program code for, if it is discriminated that said decoding method is used, setting a band height to half of that where said decoding method is not used.

ABSTRACT OF THE DISCLOSURE

A high-quality image processing apparatus capable of performing image transfer processing using a predetermined work buffer even if different decoding
5 methods are used, without physically increasing the memory capacity. Image data in page description language is inputted into a host I/F unit from an external device such as a host computer. At step S302, a print mode of the input data is examined and a coding method is
10 selected. Next, at step S303, a decoding method corresponding to the coding is checked, and at step S304, a band height (width) is set in correspondence with the decoding method. If the decoding method is a non-realtime decoding method, the band height is reduced to
15 half of that in case of realtime decoding method.

FIG. 1

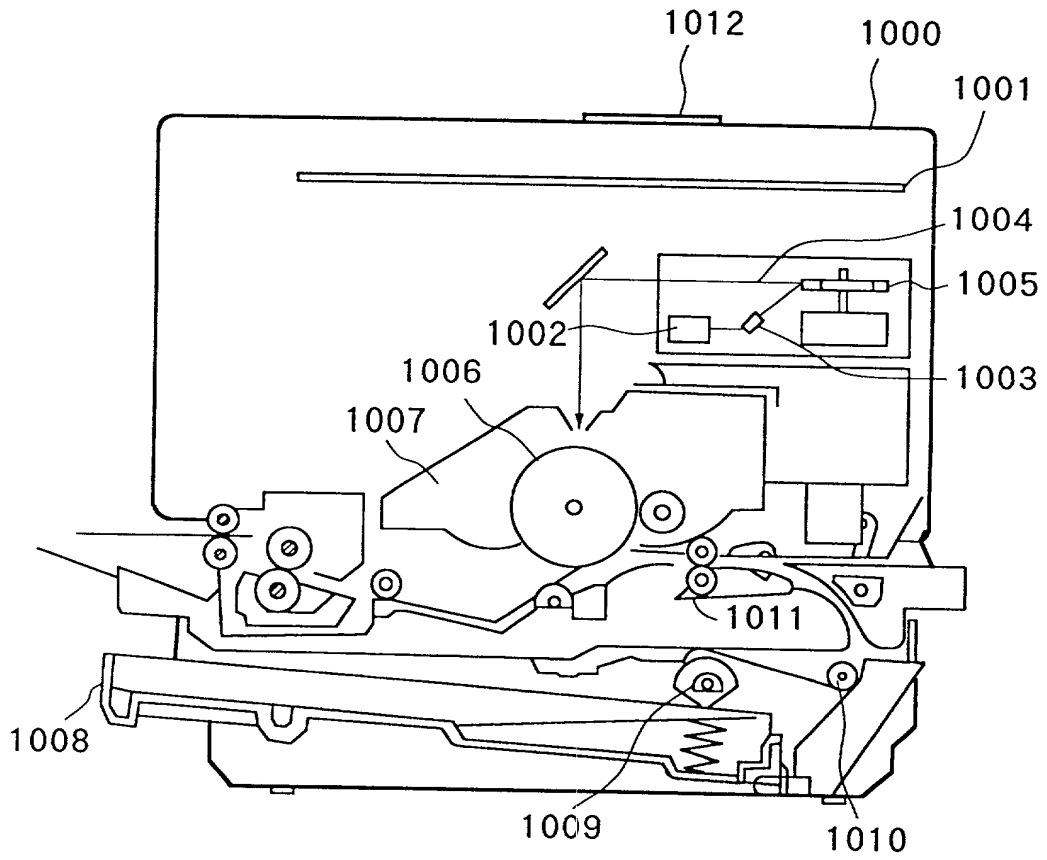
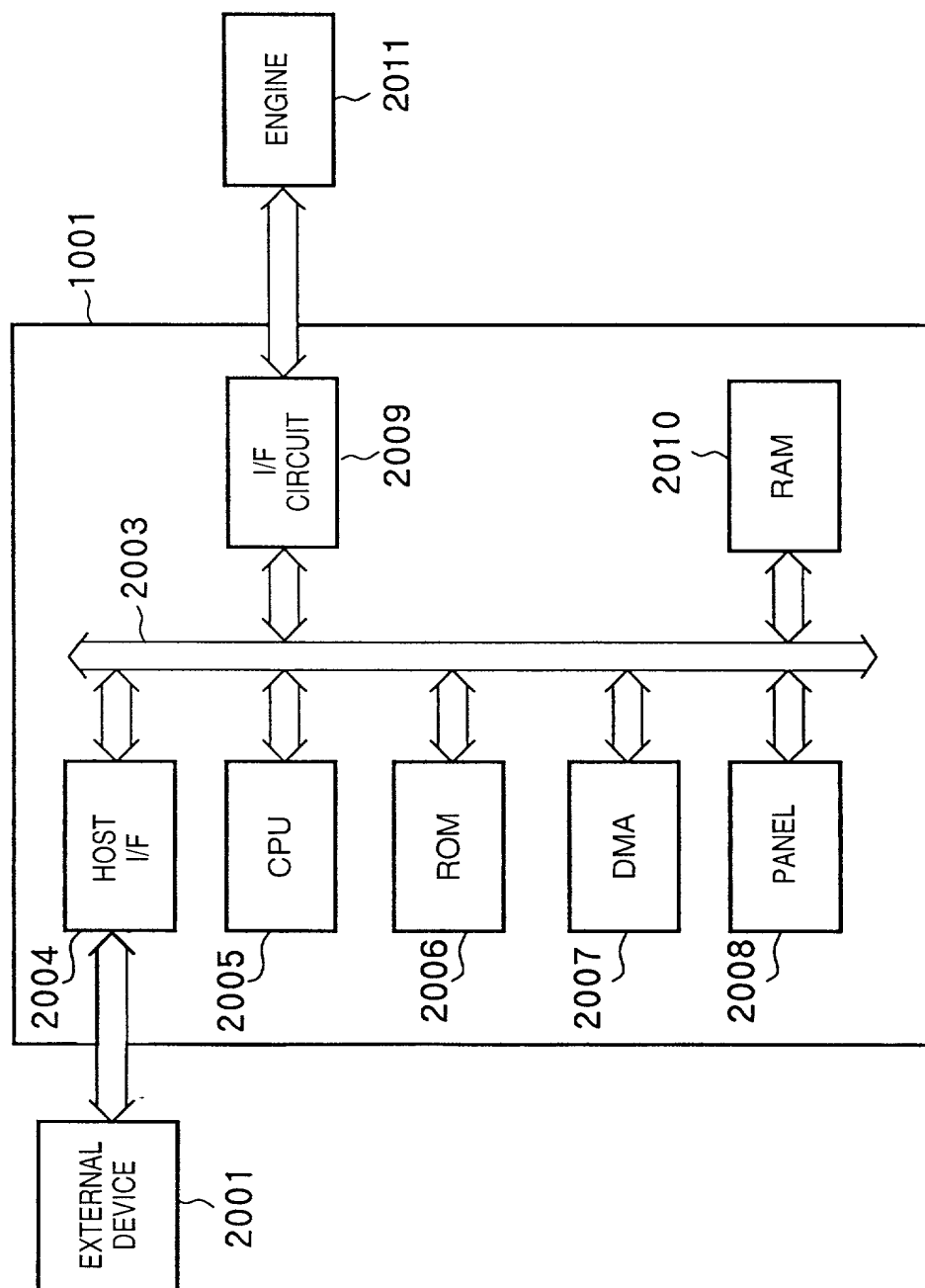


FIG. 2



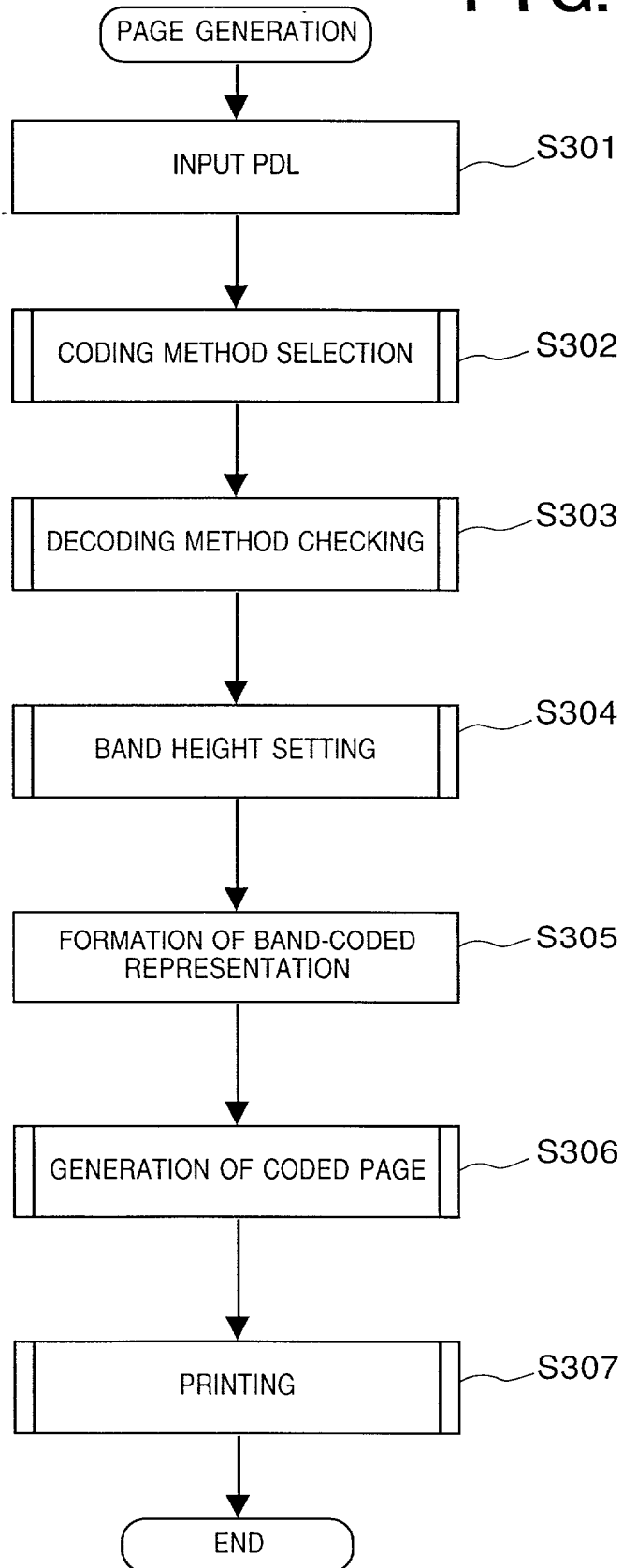


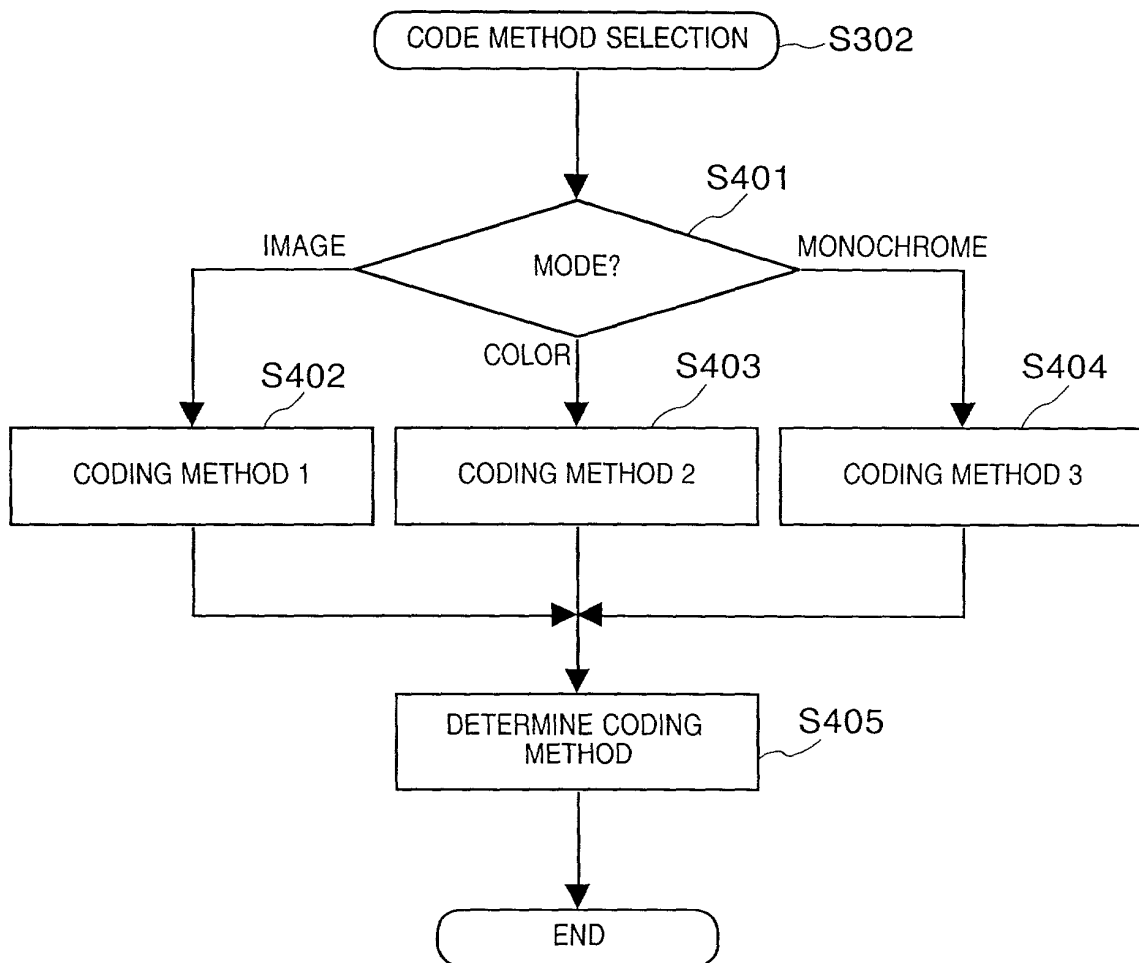
FIG. 4

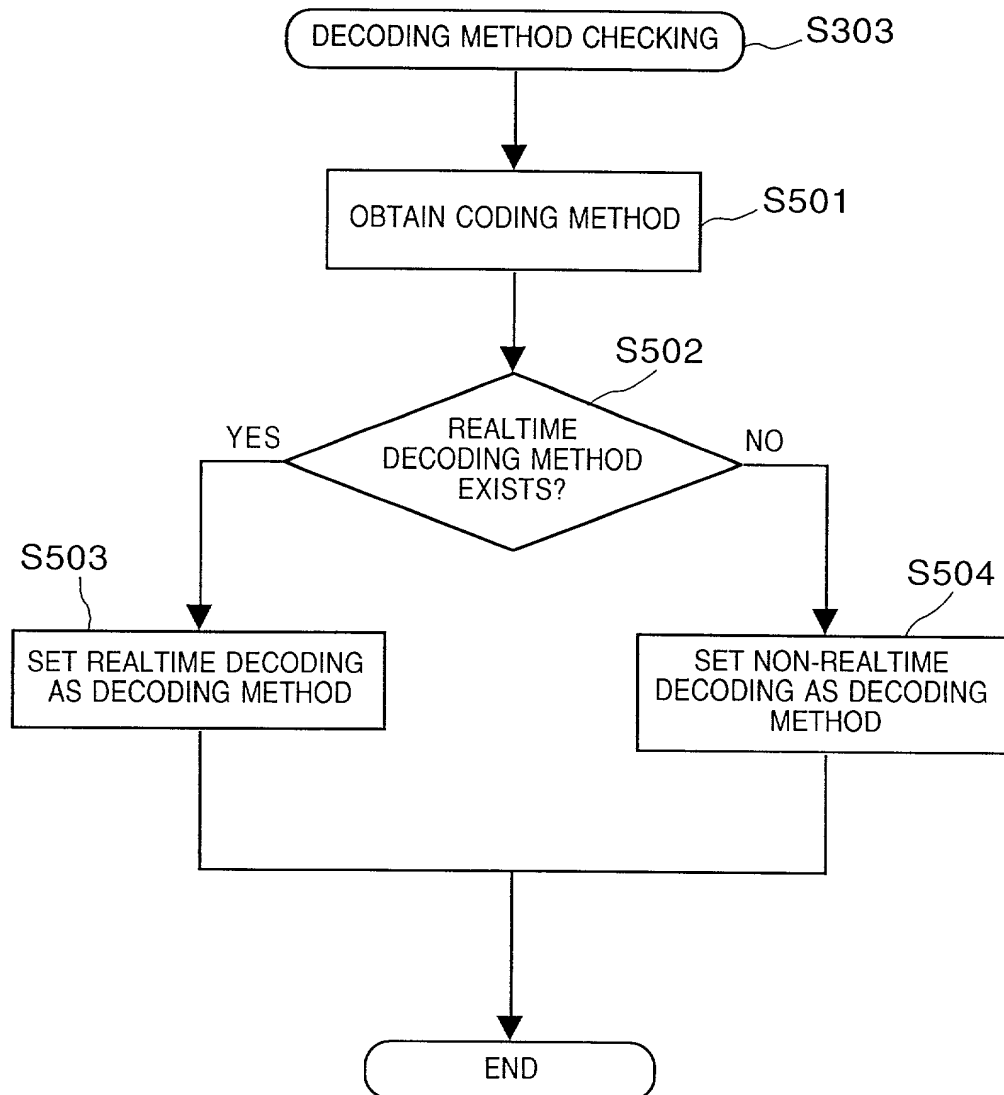
FIG. 5

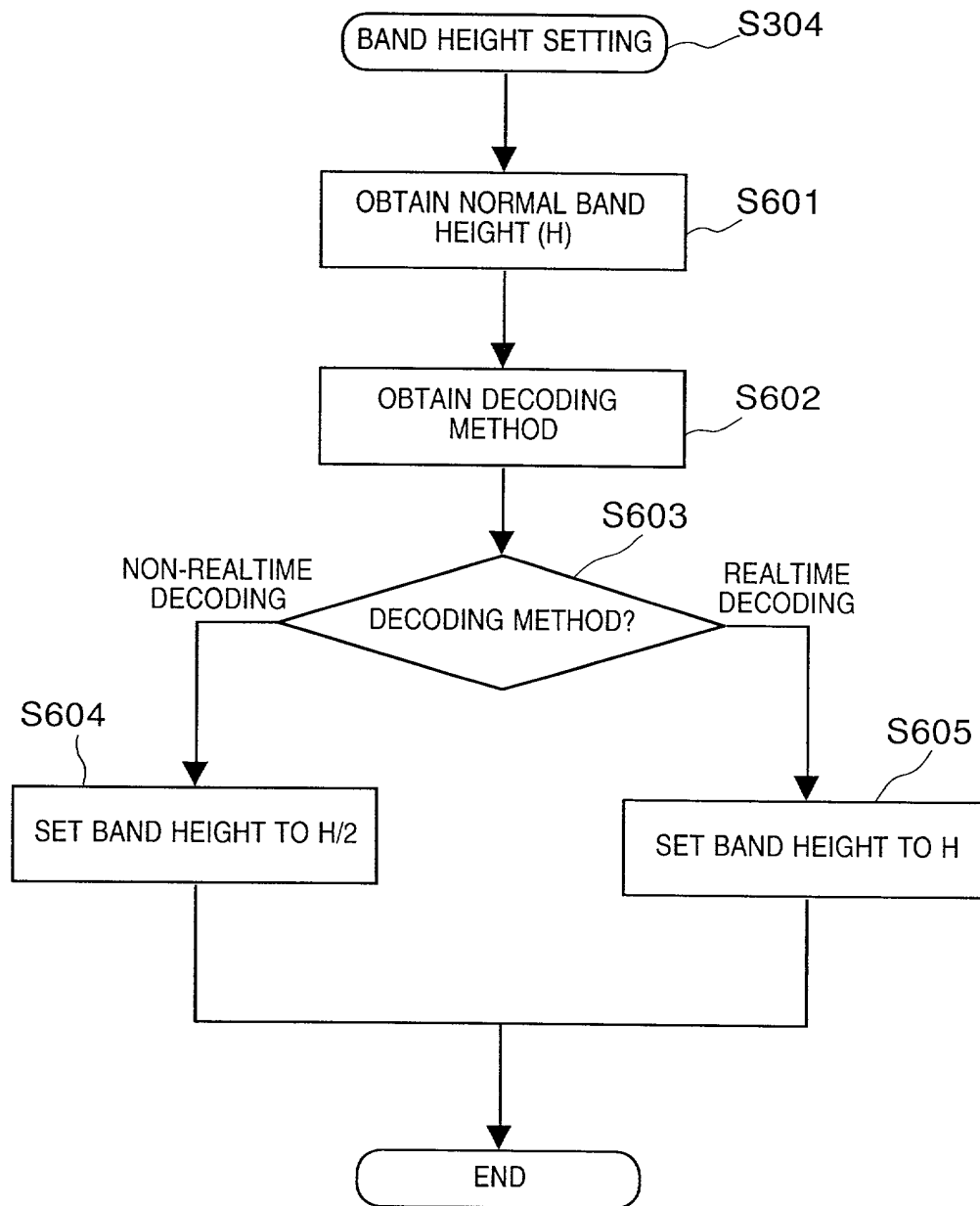
FIG. 6

FIG. 7

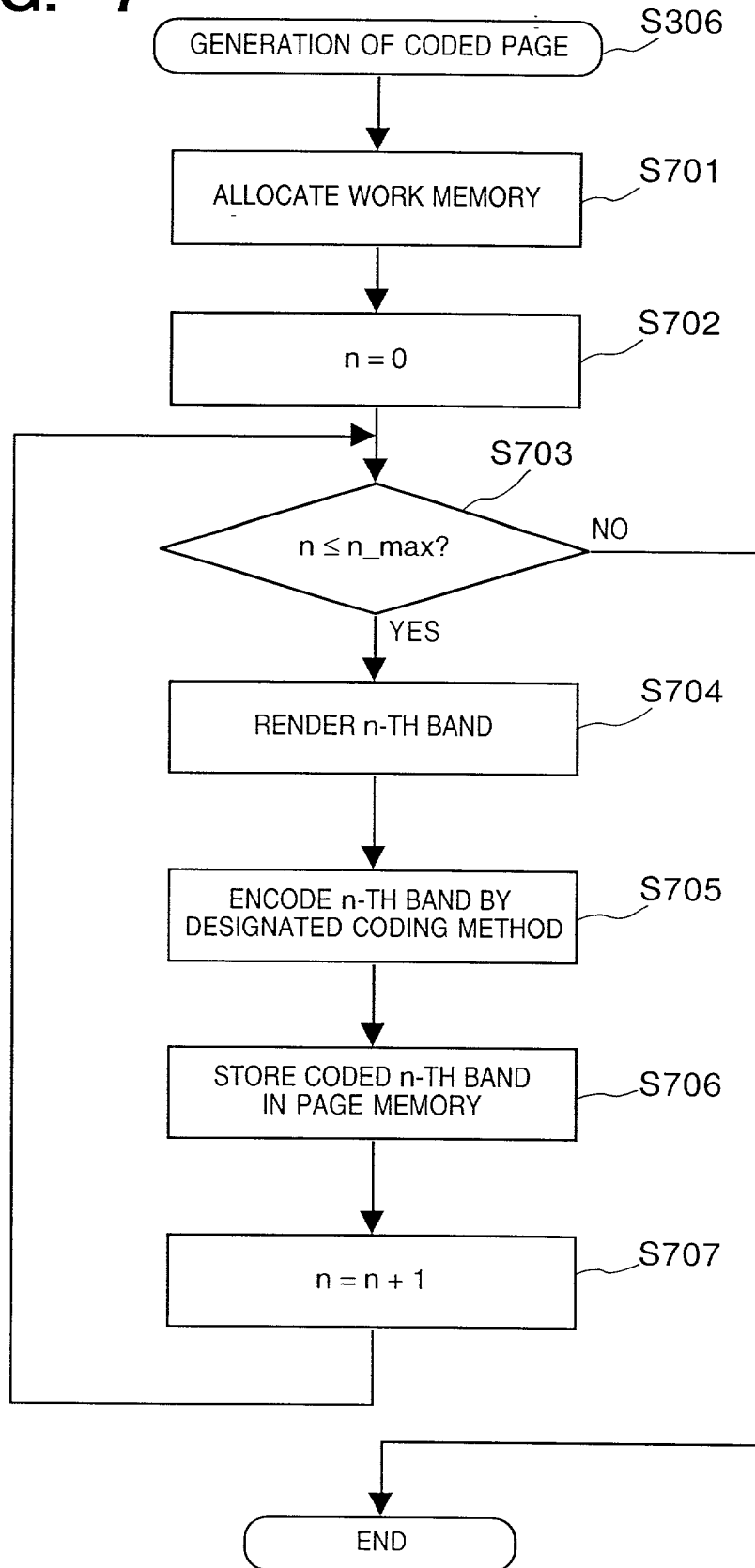


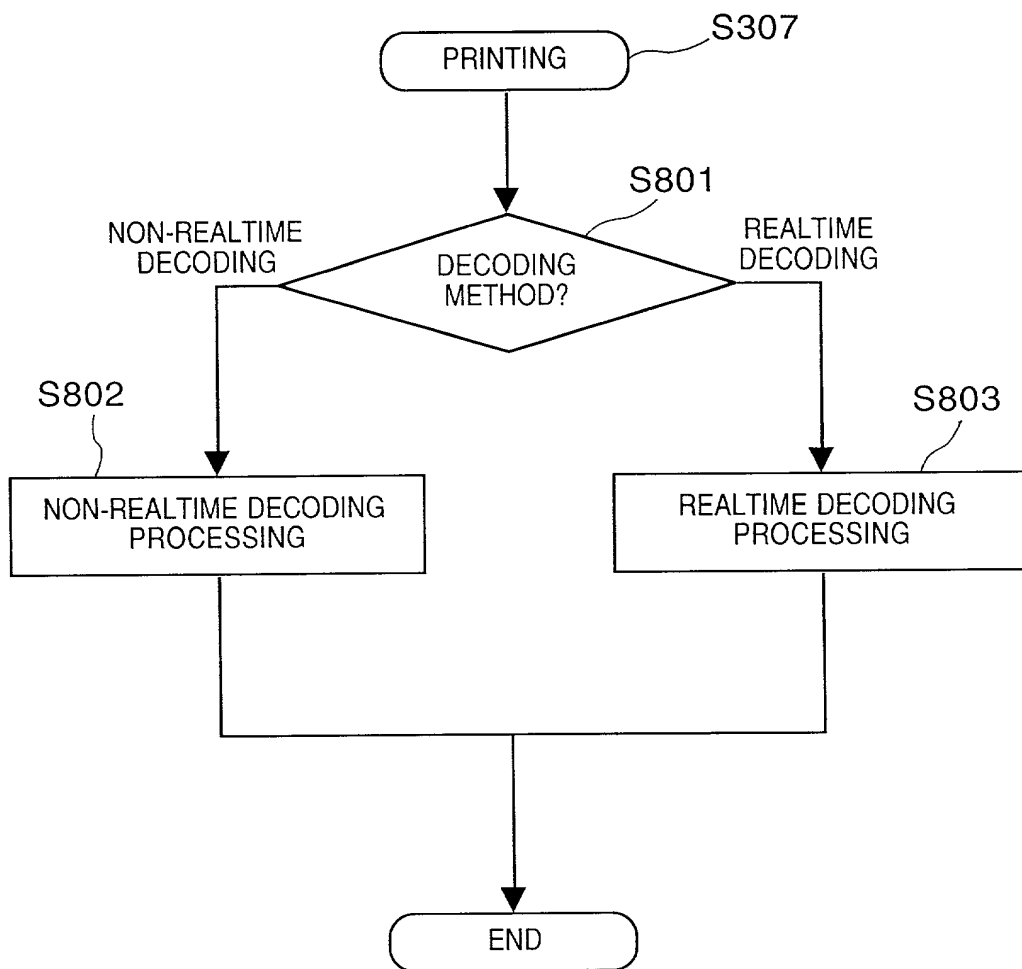
FIG. 8

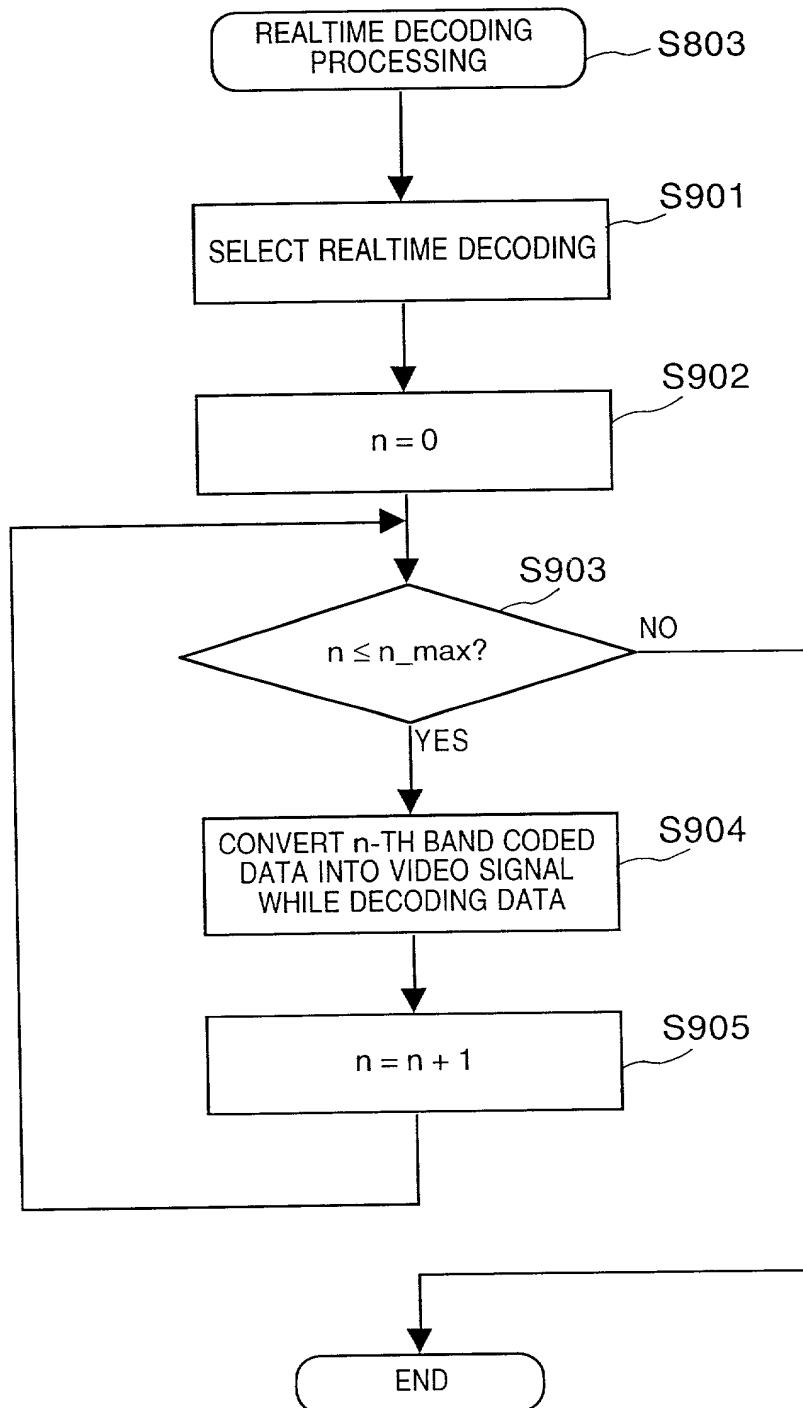
FIG. 9

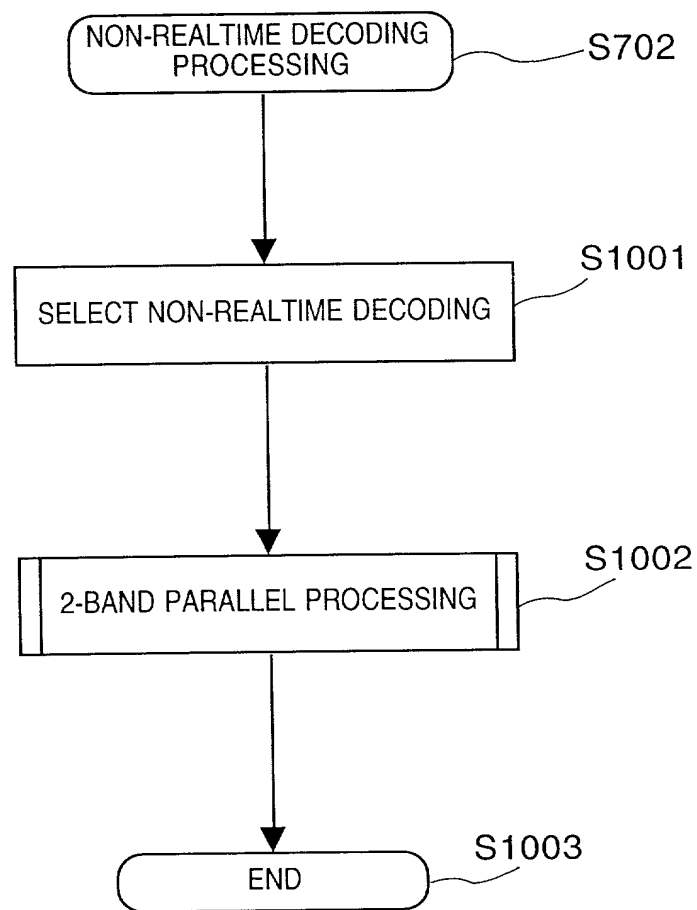
FIG. 10

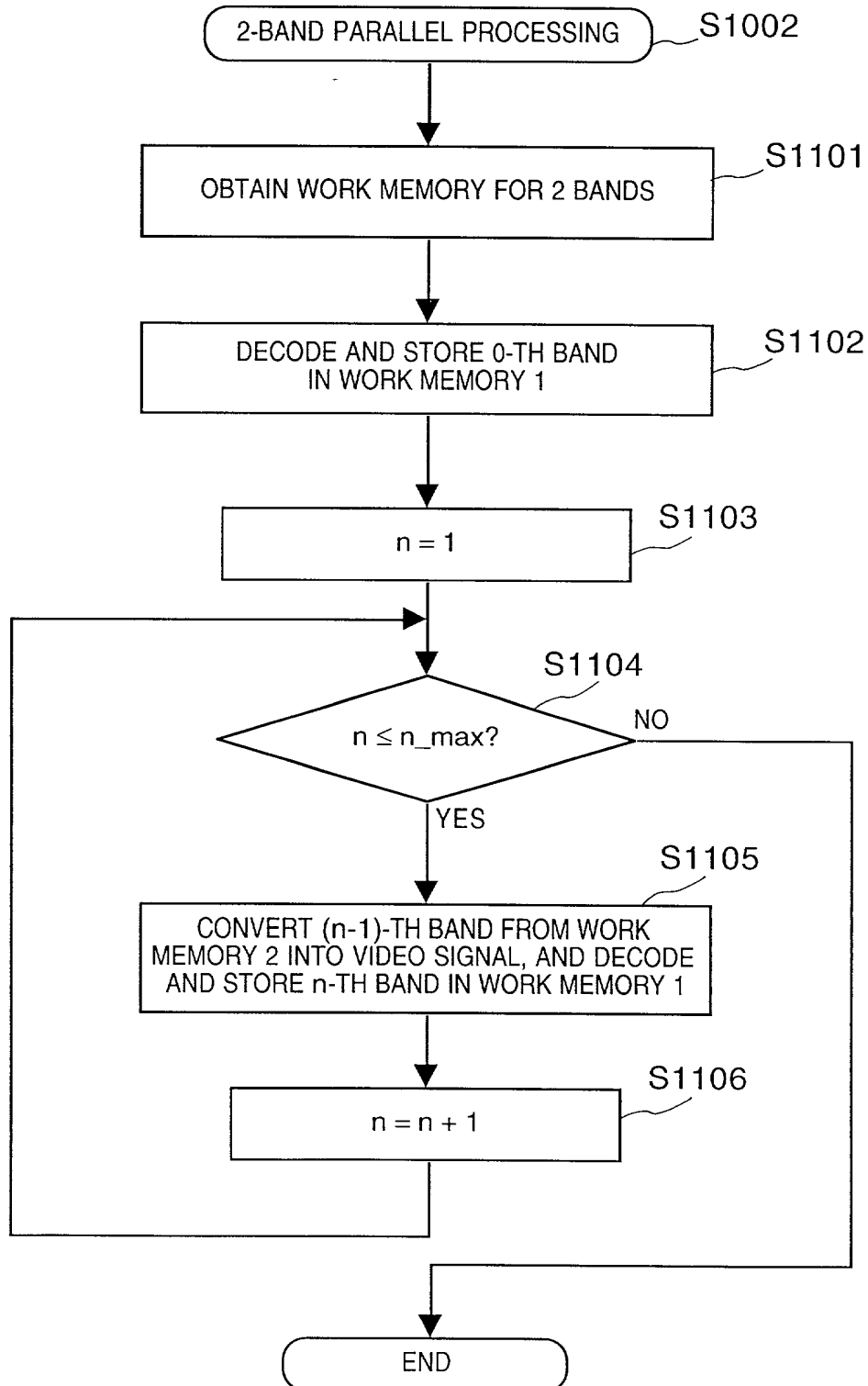
FIG. 11

FIG. 12

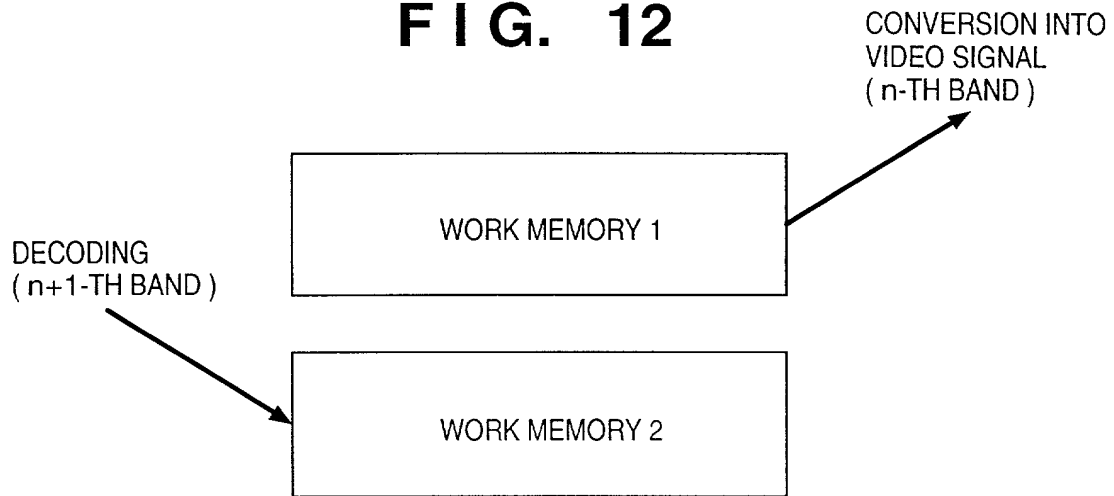


FIG. 13

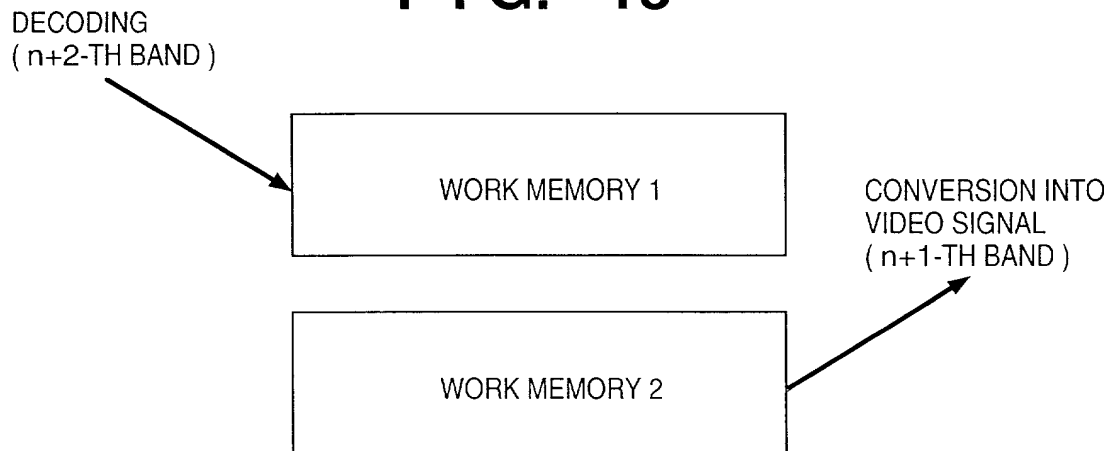


FIG. 15

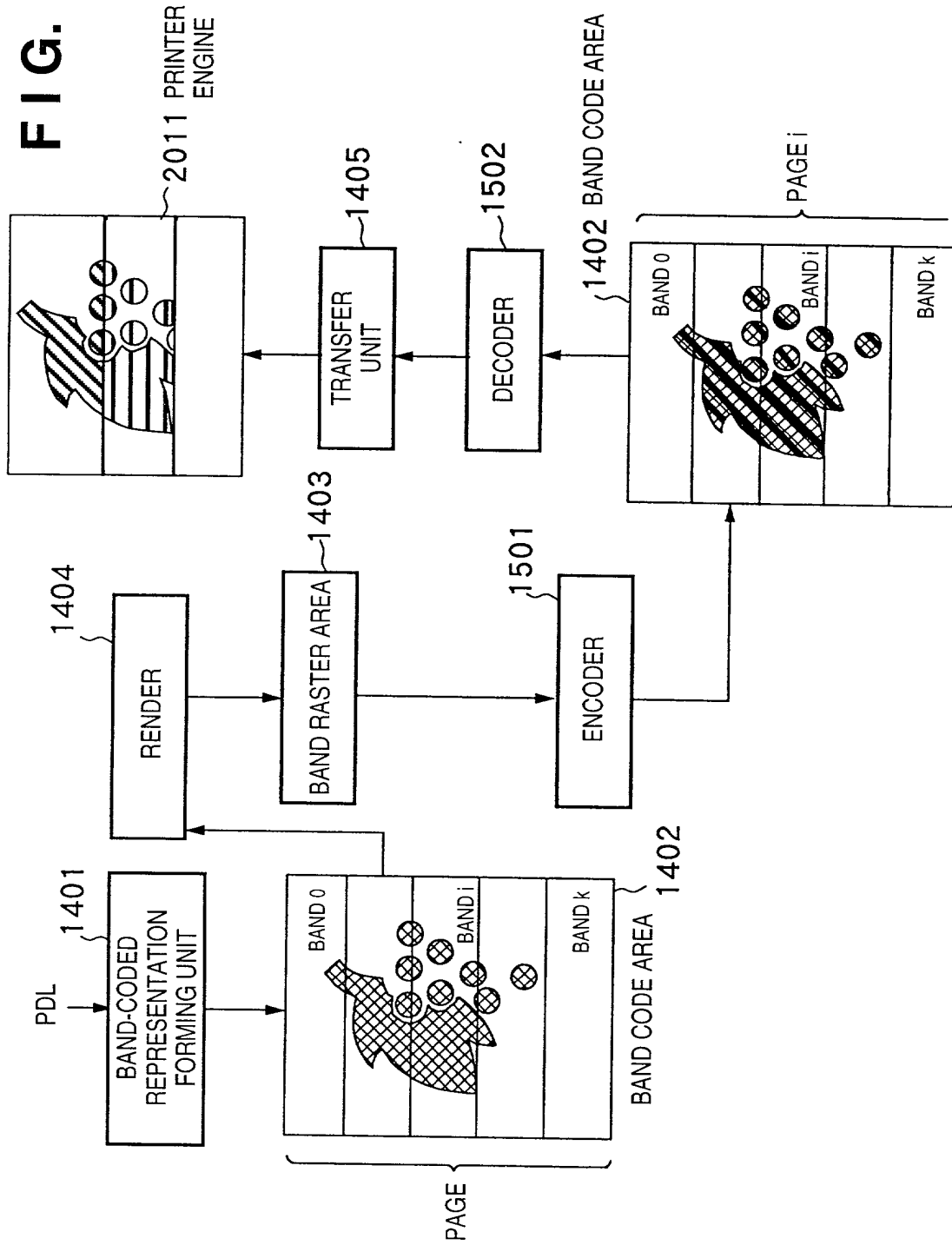
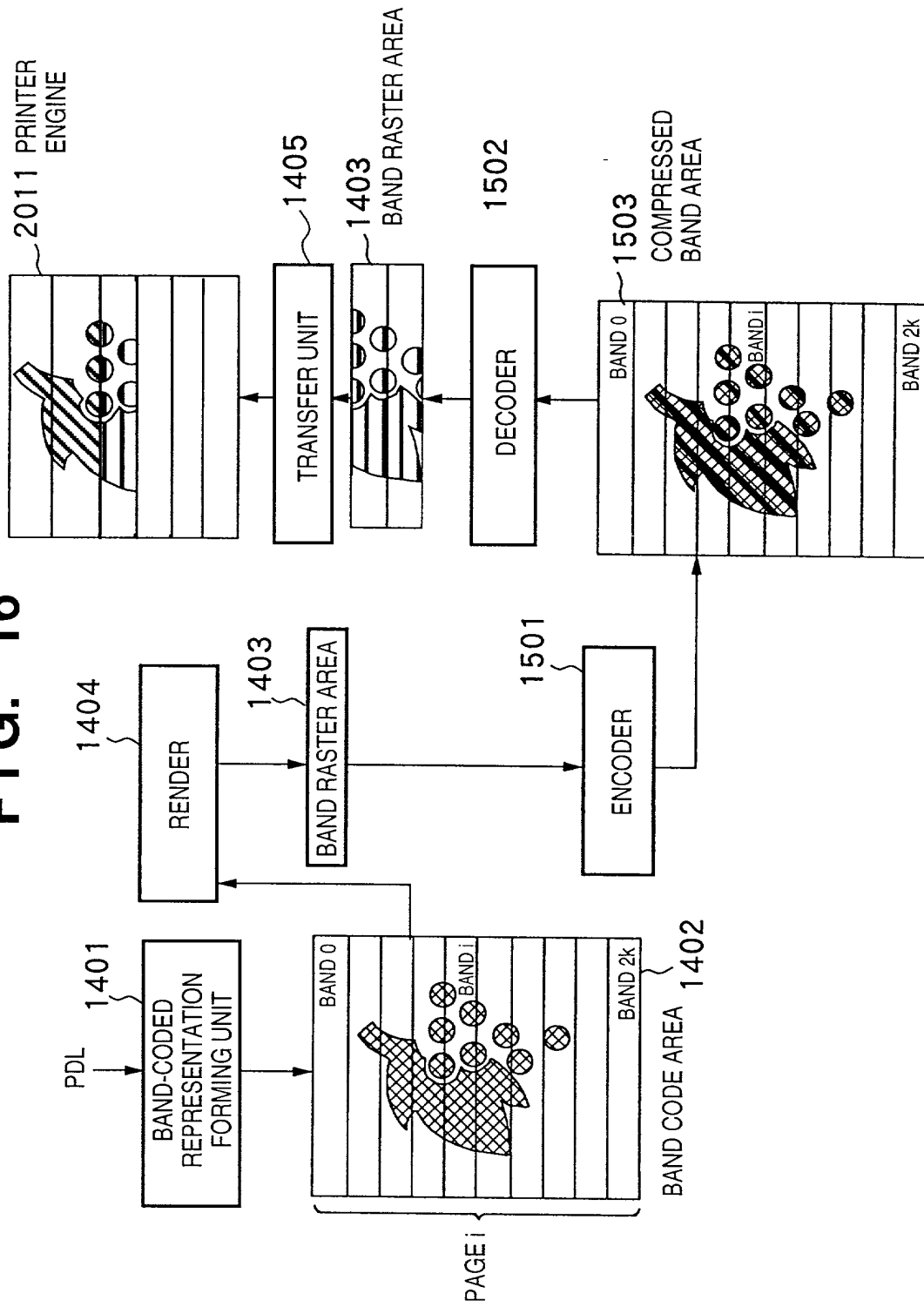


FIG. 16



**COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION**
(Page 1)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled _____

**IMAGE PROCESSING APPARATUS
AND IMAGE PROCESSING METHOD**

the specification of which ☒ is attached hereto ☐ was filed on _____
as United States Application No. or PCT International Application No. _____
and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or §365(b), of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT international application which designates at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT international application having a filing date before that of the application on which priority is claimed:

Country	Application No.	Filed (Day/Mo./Yr.)	(Yes/No) Priority Claimed
Japan	11-152812	May 31, 1999	Yes

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application

Application No.	Filed (Day/Mo./Yr.)	Status (Patented, Pending, Abandoned)
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I hereby appoint the practitioners associated with the firm and Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and direct that all correspondence be addressed to the address associated with that Customer Number:

FITZPATRICK, CELLA, HARPER & SCINTO
Customer Number: 05514

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole or First Inventor TORU WAKANA

Inventor's signature _____

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